



Matt Blunt, Governor • Doyle Childers, Director

## DEPARTMENT OF NATURAL RESOURCES

[www.dnr.mo.gov](http://www.dnr.mo.gov)

Mr. John Harpole  
Kodiak Resources, Inc.  
4880 S. Farm Road  
Rogersville, MO 65742

Dear Mr. Harpole:

Enclosed please find construction permit number SWRO – 1796 for Ridgecrest Estates Phase 1 sewer extension in Rockaway Beach, Taney County, Missouri. This permit authorizes the construction of the facilities described in the application and permit and is issued in accordance with the regulations of the Missouri Clean Water Commission. Revised engineering plans and/or specifications must be submitted prior to making any changes for the work described in the permit.

The department's review has been limited to the impact of the extension on the treatment capacity of the local wastewater facility. It is the responsibility of your consulting engineer to ensure that the design and construction conforms with all required engineering standards, state and local regulations. Department staff may conduct random, on-site inspections of some construction projects to further ensure conformity with the requirements.

This permit will expire one year from the date of issuance unless justification for extension is presented thirty (30) days prior to expiration.

The enclosed permit applies only to the construction of water pollution control components; it does not apply to other environmentally regulated areas. The enclosed permit is invalid for projects required to comply with the requirements contained in 10 CSR 20-Chapter 4, "Grants".

In addition to the requirements for a construction permit, land disturbance activities of one (1) or more acres requires a Missouri State Operating Permit to discharge stormwater (10 CSR 20-6.200). This permit requires best management practices sufficient to control runoff and sedimentation in order to protect waters of the state. For more information or to obtain the proper forms, please contact the Department of Natural Resources, Southwest Regional Office by calling 417-891-4300.

Mr. John Harpole  
Kodiak Resources, Inc  
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**Verification of compliance with 10 CSR 20-8.120, Design of Sewers; Sections (6)(G)5, Deflection Test; (6)(H)2, Leakage Test, when required by rule (required on all pressure sewers); and (11) Protection of Water Supplies will be required before authorization will be granted to place the facilities to be constructed under this construction permit into service. See the enclosed permit conditions.**

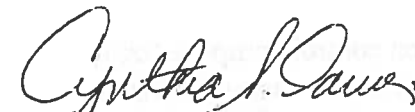
Missouri Clean Water Commission Regulations 10 CSR 20-6.010(5)(D) and 10 CSR 20-6.010(6)(B) require that the engineer certify that the construction has been completed in accordance with the approved plans and specifications and requires that the owner or continuing authority apply for a Letter of Authorization. The enclosed Application for Letter of Authorization shall be completed by both the engineer and the owner / continuing authority and returned to the Southwest Regional Office. A copy of the consulting engineer's field notes must accompany the application.

If you were affected by this decision, you may appeal to have the matter heard by the administrative hearing commission. To appeal, you must file a petition with the administrative hearing commission within thirty days after the date this decision was mailed or the date it was delivered, whichever date was earlier. If any such petition is sent by registered mail or certified mail, it will be deemed filed on the date it is mailed; if it is sent by any method other than registered mail or certified mail, it will be deemed filed on the date it is received by the administrative hearing commission.

If you have questions please contact Mr. Megan L. Hart, E.I., by calling 417-891-4300 or via mail at Southwest Regional Office, 2040 W. Woodland, Springfield, Missouri 65807-5912.

Sincerely,

SOUTHWEST REGIONAL OFFICE



Cynthia S. Davies  
Regional Director

CSD/mhh

Enclosures

c: City of Rockaway Beach  
Mr. Gregory Whitlock, P.E., Great River Engineering

**TANEY / WPC  
ROCKAWAY BEACH, CITY OF - CP  
RIDGECREST ESTATES PHASE 1**

**Construction Permit SWRO-1796**

**STATE OF MISSOURI  
DEPARTMENT OF NATURAL RESOURCES**

MISSOURI CLEAN WATER COMMISSION



# CONSTRUCTION PERMIT

The Missouri Department of Natural Resources hereby issues a permit to:

**John Harpole  
Kodiak Resources, Inc.  
4880 S. Farm Road  
Rogersville, MO 65742**

for the construction of (described facilities):

**(SEE ATTACHED FACILITY DESCRIPTION)**

Permit Conditions:

**(SEE ATTACHED PERMIT CONDITIONS)**

Construction of such proposed facilities shall be in accordance with the provisions of the Missouri Clean Water Law, Chapter 644, RSMo, and regulation promulgated thereunder, or this permit may be revoked by the Department of Natural Resources.

As the Department of Natural Resources does not examine structural features of design or the efficiency of mechanical equipment, the issuance of this permit does not include approval of these features.

A representative of the department may inspect the work covered by this permit during construction. Issuance of a permit to operate by the department will be contingent on the work substantially adhering to the approved plans and specifications.

This permit applies only to the construction of water pollution control components; it does not apply to other environmentally regulated areas.

February 26, 2007

Effective Date

February 25, 2008

Expiration Date

Doyle Childers, Director, Department of Natural Resources  
Executive Secretary, Clean Water Commission

Cynthia S. Davies, Regional Director, Southwest Regional Office

#### FACILITY DESCRIPTION:

Project includes wastewater collection facilities designed in accordance with MCWC Regulation 10 CSR 20-8.110 through 8.500 which are applicable to facilities that have or are part of larger facilities that have a design average day flow greater than 22,500 gallons per day.

These facilities will serve 160 multi-family apartment units, Highway F, located in SW ¼, NW ¼, SW ¼, Sec. 3, T23N, R21W, Taney County, Missouri.

The design average day flow is estimated to be 59,200 gallons per day, or 2,466.67 gallons per hour, or 41.11 gallons per minute containing an estimated 100.64 pounds per day of five-day biochemical oxygen demand (BOD<sub>5</sub>). The organic population equivalent is estimated to be 592 based on 0.17 LB BOD<sub>5</sub> / person / day. The hydraulic population equivalent is estimated to be 592 based on 100 gallons / person / day. The design peak day flow to design average day flow ratio based on MCWC Regulation 10 CSR 20-8.120(5)(B) is estimated to be:

$$\frac{18 + \left[ \frac{(\text{hydraulic population equivalent})}{(1,000)} \right]^{0.5}}{4 + \left[ \frac{(\text{hydraulic population equivalent})}{(1,000)} \right]^{0.5}} = \frac{18.769}{4.769} = 3.936$$

The design peak day flow is estimated to be (3.936) (59,200) = 233,011.2 gallons per day, 9,708.8 gallons per hour, or 161.81 gallons per minute.

The design average day raw wastewater organic strength is

$$\left( \frac{100.6 \text{ LB BOD}_5/\text{day}}{59,200 \text{ gallon / day}} \right) \left( \frac{\text{gallon}}{3.785 \text{ L}} \right) \left( \frac{453590 \text{ mg BOD}_5}{\text{LB BOD}_5} \right) = 203.73 \text{ mg BOD}_5 / \text{L}$$

#### Brief Wastewater Collection Facility Description

##### STANDARD TECHNOLOGY COMPONENTS

Note that standard technology includes components designed in accordance with Missouri Clean Water Commission (MCWC) Regulation 10 CSR 20-8.110 through 8.500 as well as components not included in the regulations, but which meet Southwest Regional Office (SWRO) design guidance. The design guidance components are allowed as new technology under MCWC Regulation 10 CSR 20-8.140(5)(B). The limited department engineering review, which is the basis for this permit was focused only on sizing major components, which are listed in this section.

Note that the minimum sizes or capacities listed as requirements for these major components do not include any safety factor applied by the design engineer or additional capacity provided by the design engineer for future growth. The limited department engineering review did not include review of construction requirements for major components other than sizing and did not include review of required minor components. However, these are still mandatory and are listed in detail in a later section of this permit. It is the design engineer's responsibility to ensure the design meets these requirements.

**(A) Gravity Sewers**

Actual design includes 3,420 linear feet of eight-inch (8") nominal diameter gravity sewer line and twenty-nine (29) manhole(s).

**NON-STANDARD TECHNOLOGY COMPONENTS**

Note the responsibility for non-standard technology rests solely with the design engineer. Non-standard technology is allowed as new technology under Missouri Clean Water Commission (MCWC) Regulation 10 CSR 20-8.140(5)(B). A schedule of compliance to assess the effectiveness of the non-standard technology will be included in the Missouri State Operating Permit (MSOP). The use of non-standard technology may have a significant degree of risk.

**(A) None**

Wastewater will be received by the City of Rockaway Beach wastewater treatment facility.

**Wastewater Collection Facility Construction Requirement**

Construction requirements for standard technology major components listed in the brief wastewater collection facility description are included in this section and are mandatory. Minor components, which are required but not listed in the brief wastewater collection facility description are included in this section and are mandatory. Generic construction requirements for many types of components (bedding depth, bedding material requirements, separation from water main requirements, etc.) are listed in this section and are mandatory.

Standard technology construction requirements for missing components or non-standard technology components that would otherwise be considered standard technology except that regulatory requirements or Southwest Regional Office (SWRO) design guidance requirements were not met are also listed in this section for information purposes but these requirements are not necessarily applicable.

**(A) Gravity Sewers**

Gravity sewer line shall be laid between manholes and other appurtenances with straight alignment at a uniform slope equal to or greater than the regulatory minimum of:

Nominal Sewer Diameter (inches)	Minimum Slope (feet/100 feet)	Nominal Sewer Diameter (inches)	Minimum Slope (feet/100 feet)
6	0.60	16	0.14
8	0.40	18	0.12
9	0.33	21	0.10
10	0.28	24	0.08
12	0.22	27	0.067
14	0.17	30	0.058
15	0.15	36	0.046

Note that six inch (6") gravity sewer line is not allowed except in special circumstances (continuing authorities, which were allowed to install this undersized pipe under innovative/alternative procedures in the past, may continue to install six inch (6") gravity sewer lines if it has adequate capacity). Note that 9, 14, and 16 inch diameters are not available in commonly used ASTM D 3034 SDR-35 sewer pipe, ASTM D 3034 SDR-26 sewer pipe, or ASTM F 679 T-1 and T-2 large diameter sewer pipe.

Pipe with thickness and strength equal to or greater than that of ASTM D 3034 SDR-35 shall be used for gravity sewers with nominal diameters of six inch (6") through 15 inch (15") in ordinary soil conditions at ordinary depths. Pipe with thickness and strength equal to or greater than ASTM F 679 T-2 shall be used for gravity sewers with nominal diameters of 18 inch (18") through 36 inch (36") in ordinary soil conditions at ordinary depths. Determination of ordinary soil conditions and ordinary depths is the responsibility of the design engineer. Ordinary soil conditions are normally soils classified ASTM D 2487 Class II, Class III, and Class IVA. Ordinary depths are normally 12 feet (12') or less. Higher strength pipe such as ASTM D 3034 SDR-26 or ASTM D 2241 SDR-21 shall be used in problem soil conditions and at deeper depths. Minimum cover depth over the gravity sewer pipe shall be 30 inches (30").

The combination of gravity sewer average inside diameter and flattest slope shall result in capacity sufficient to carry design peak day flow when calculated using Kutter's formula with an "n" value of 0.013. Kutter's formula is:

$$V = \left( \frac{\frac{1.81}{n} + 41.67 + \frac{0.0028}{Se}}{1 + \frac{n}{\sqrt{R}} \left( 41.67 + \frac{0.0028}{Se} \right)} \right) (R Se)^{0.5}$$

Where: V is mean flow velocity in feet per second (fps)  
R is hydraulic radius in feet  
n is coefficient of roughness = 0.013  
Se is slope of the energy line in feet per feet;

Hydraulic Radius =  $\frac{\text{cross section area of flow}}{\text{Wetted perimeter}}$  or  $\frac{\text{average inside diameter in feet}}{4}$

for pipes flowing full.

Average Inside Diameter (ID) for ASTM D 3034 PVC and ASTM F 679 PVC =  
= Average OD - (2)(1.06) (minimum wall thickness)

Average Inside Diameter for ASTM D 2241 PVC =  
= Average OD - 2 (minimum wall thickness + ½ wall thickness tolerance)

Pipe dimensions for commonly used PVC gravity sewer pipe and capacity at regulatory minimum slope based on Kutter's Formula with  $n = 0.013$  are:

Pipe Description & Nominal Diameter	Average Outside Diameter (inches)	Minimum Wall Thickness (inches)	Wall Thickness Tolerance (inches)	Average Inside Diameter (inches)	Cross Sectional Area of Flow (Feet <sup>2</sup> )	Hydraulic Radius Flowing Full (Feet)	Capacity at Regulatory Minimum Slope Based on Kutter's (gallon/day)
ASTM D 3034 SDR-35 6"	6.275	0.180	-	5.893	0.1894	0.1228	235,100
ASTM D 3034 SDR-35 8"	8.400	0.240	-	7.891	0.3396	0.1644	433,500
ASTM D 3034 SDR-35 10"	10.500	0.300	-	9.864	0.5307	0.2055	673,000
ASTM D 3034 SDR-35 12"	12.500	0.360	-	11.737	0.7513	0.2445	963,900
ASTM D 3034 SDR-35 15"	15.300	0.437	-	14.374	1.1269	0.2994	1,386,800
ASTM D 2241 SDR-21 16"	16.000	0.762	+0.091	14.385	1.1286	0.2997	1,341,700
ASTM F 679 T-2 18"	18.701	0.499	-	17.643	1.6977	0.3676	2,172,900
ASTM F 679 T-2 21"	22.047	0.588	-	20.800	2.3597	0.4333	3,105,100
ASTM F 679 T-2 24"	24.803	0.661	-	23.402	2.9870	0.4875	3,818,900
ASTM F 679 T-2 27"	27.953	0.745	-	26.374	3.7938	0.5495	4,827,000
ASTM F 679 T-2 30"	31.496	0.840	-	29.715	4.8159	0.6191	6,195,600
ASTM F 679 T-2 36"	39.370	1.050	-	37.144	7.5250	0.7738	10,059,200

PVC gravity sewer pipe laid at slopes equal to or greater than 20% and PVC gravity sewer pipe for which the combination of average inside diameter and slope result in a velocity greater than 15 feet per second (fps) when calculated using Kutter's Formula with an "n" value of 0.013 shall have mechanical restraints or poured concrete slope anchors with steel tie-down bars bearing against undisturbed earth at pipe bells at a maximum spacing (center to center) of 36 feet (36') for slopes up to 35%, 24 feet (24') for slopes greater than 35% up to 50%, and 16 feet (16') for slopes greater than 50%. Slope anchors shall be constructed to ASTM F 1668 Standard Guide for Construction Procedures for Buried Plastic Pipe. Slopes at which slope anchors (or mechanical restraints) are required for commonly used PVC gravity sewer pipes are:

Pipe Description & Nominal Diameter	Slope at which Slope Anchors are Required	Pipe Descriptions & Nominal Diameter	Slope at which Slope Anchors are Required
ASTM D 3034 SDR-35 6"	20.00%	ASTM F 679 T-2 18"	>6.709%
ASTM D 3034 SDR-35 8"	20.00%	ASTM F 679 T-2 21"	>5.276%
ASTM D 3034 SDR-35 10"	>16.12%	ASTM F 679 T-2 24"	>4.451%
ASTM D 3034 SDR-35 12"	>12.35%	ASTM F 679 T-2 27"	>3.751%
ASTM D 3034 SDR-35 15"	>9.098%	ASTM F 679 T-2 30"	>3.169%
ASTM D 2241 SDR-21 16"	>9.084%	ASTM F 679 T-2 36"	>2.322%

Minimum trench bottom width for PVC gravity sewer line laid in ordinary soils shall be the greater of: pipe average outside diameter plus 16 inches; or pipe average outside diameter times 1.25 plus 12 inches (12") as outlined in ASTM D 2321 Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Applications referenced in MCWC Regulation 10CSR20-8.120(6)(G). Minimum trench bottom widths for commonly used PVC gravity sewer pipe are:

Pipe Description & Nominal Diameter	Minimum Trench Width (inches)	Pipe Description & Nominal Diameter	Minimum Trench Width (inches)
ASTM D 3034 SDR-35 6"	22.3	ASTM F 679 T-2 18"	35.4
ASTM D 3034 SDR-35 8"	24.4	ASTM F 679 T-2 21"	39.6
ASTM D 3034 SDR-35 10"	26.5	ASTM F 679 T-2 24"	43.0
ASTM D 3034 SDR-35 12"	28.5	ASTM F 679 T-2 27"	46.9
ASTM D 3034 SDR-35 15"	31.3	ASTM F 679 T-2 30"	51.4
ASTM D 2241 SDR-21 16"	32.0	ASTM F 679 T-2 36"	61.2

All gravity sewer lines shall be constructed to be sufficiently watertight to meet regulatory infiltration and exfiltration rates less than or equal to 200 gallons per inch of pipe diameter per mile of pipe length per day. PVC gravity sewers with nominal diameter greater than 27 inches (27") shall be tested to ensure the maximum 200 gallons per inch of pipe diameter per mile of pipe length per day water infiltration and exfiltration rate or the equivalent air leakage rate less than or equal to 0.0015 cubic feet air per minute per square feet of pipe inside surface area are met. Acceptable test methods are outlined in ASTM F 1417 Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air and in ASTM C 969 Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Pre Cast Concrete Pipe Sewer Lines.

Embedment for PVC gravity sewer pipe in ordinary trench conditions with or without high groundwater and with or without a hydraulic gradient shall be ASTM D 2487 Class IB dense graded, clean, manufactured, and processed aggregates described as angular crushed stone, crushed rock, or crushed gravel and crushed stone/sand mixtures containing little or no fines with gradations selected to minimize migration of adjacent soils. Class IB aggregates must be compacted to 85% standard proctor density and tested to ensure proper compaction. Sieve requirements for Class IB aggregates for various PVC gravity sewer pipe nominal diameters are shown below.

Embedment for PVC gravity sewer pipe in ordinary trench conditions without high groundwater and without a hydraulic gradient when ASTM D 2487 Class IB aggregate is not used, shall be ASTM D 2487 Class IA open graded, clean, manufactured aggregates described as angular crushed stone, crushed rock, or crushed gravel with large void content containing little or no fines. Class IA aggregates must be compacted. Sieve requirements for Class IA aggregates for various PVC gravity sewer pipe nominal diameters are shown below.

Nominal pipe diameter (inch)	Bedding material ASTM D 2487 Class	Amounts Finer Than Each Laboratory Sieve (Square Openings) Mass Percent					
		Sieve Size					
		1 ½ inch (37.5 mm)	¾ inch (19 mm)	½ inch (12.5mm)	3/8 inch (9.75mm)	No. 4 (4.75mm)	No. 200 (0.075mm)
4	IA				100%	≤ 10%	≤ 5 %
4	IB				100%	≤ 50%	≤ 5 %
6	IA			100 %		≤ 10%	≤ 5 %
6	IB			100%		≤ 50%	≤ 5 %
8 to 15	IA		100%			≤ 10%	≤ 5 %
8 to 15	IB		100%			≤ 50%	≤ 5 %
≥ 16	IA	100%				≤ 10%	≤ 5 %
≥ 16	IB	100%				≤ 50%	≤ 5 %

Sieve size passing 100% for four-inch (4") and six-inch (6") nominal pipe size based on ASTM D 2321 requirement of approximately 10% of pipe diameter for pipes less than eight-inches (8"). Metric equivalents of inch sizes are from ASTM C 33. Note that 4" pipe is not allowed for sewer mains but is widely used for service connections and 6" pipe is only allowed for sewer main in limited circumstances.



ASTM D 2487 Class IA and IB embedment shall extend from four inches (4") below the gravity sewer line (from six inches (6") below the gravity sewer line in rock) to six inches (6") above the gravity sewer line as outlined in ASTM D 2321.

High strength embedment (steel reinforced concrete low cradle, steel reinforced concrete high cradle, steel reinforced concrete encasement, or steel reinforced concrete arch constructed to ASTM C 12 (standards for Class A embedment) shall be used for problem soil conditions, near Karst features including caves and sink holes, for road crossings, for stream crossings, for water main/sewer main crossings, and for sewer main/stormwater conduit crossings.

All PVC gravity sewer lines shall be constructed so that deflection of the minimum inside pipe diameter is less than equal to five percent (5%) as demonstrated by a deflection test conducted no less than 30 days after final back filling by pulling a mandrel with a diameter equal to or greater than 95% of the minimum inside pipe diameter through the sewer pipe without mechanical pulling device.

Manholes shall be either poured in place concrete or constructed of precast concrete components. Standard manholes shall be installed where sewer lines enter the manholes at elevations less than 24 inches (24") above the invert. Drop manholes shall be installed where sewer lines enter the manholes at elevations equal to or greater than 24 inches (24") above the invert. All manholes shall be constructed to be sufficiently water tight to meet infiltration and exfiltration rates less than equal to 200 gallons per inch of manhole diameter per mile of manhole depth per day including installation of flexible gaskets (A-Loks or equivalent) at all lines entering and exiting the manhole, including installation of flexible gaskets (RamNek or equivalent) between all precast concrete components, including application of a waterproof coating on the manhole exterior, and including installation of water tight lids where manhole tops are subject to being submerged by surface water from street run off or other high water conditions. Manholes connected to PVC gravity sewers with nominal diameters greater than 27 inches (27") shall be tested to ensure the infiltration/exfiltration rate or the equivalent vacuum leakage rate is met. Acceptable test methods are ASTM C 969 Standard Practice For Infiltration and Exfiltration Acceptance Testing of Installed Pre Cast Concrete Pipe Sewer Lines and ASTM C1244 Standard Test Method For Concrete Sewer Manholes by the Negative Air (Vacuum) Test.

All manhole inverts shall be smoothly finished, poured concrete with the flow channel conforming to the shape and slope of the sewer with the channel uniformly curved from inlet to outlet where bends occur and with separate channels for each inlet pipe with the channels gradually merging ahead of the outlet with uniform curves where two (2) or more inlet pipes enter a manhole.

All manholes shall have a minimum inside diameter equal to or greater than 48 inches (48") below the eccentric cone (42 inch (42") diameter is allowed for eight inch (8") sewer but rarely used) and have a minimum access diameter equal to or greater than 22 inches (22"). Larger diameter manholes are required for larger diameter sewers to maintain structural integrity.

Drop manholes with interior drop pipes shall have the drop pipes secured to the manhole interior wall and have access ports for cleaning. Drop manholes with exterior drop pipes shall have the drop pipe encased in concrete or otherwise supported to prevent movement.

Manholes shall be installed at all changes in grade, pipe size, alignment; at all intersections; at distances not greater than 400 feet (600 feet if the continuing authority has cleaning/rodding equipment for this manhole spacing); and at the ends of all sewer lines except that cleanouts/lampholes with a minimum diameter of eight inches (8") constructed with water tight lids may be installed at the end of laterals which have length less than or equal to 150 feet.

Gravity sewer lines and drinking water lines shall be laid so that there is not permanent physical connection between a potable water supply and any sewer, sewage treatment device or appurtenance; shall be laid so that no drinking water line passes through or has any contact with any part of a sewer manhole, shall be laid in parallel with a horizontal separation equal to or greater than ten feet (10') with the distance between the gravity sewer line and drinking water line measured edge to edge; or shall be laid in parallel with a horizontal separation less than ten feet (10') with the gravity sewer line and the drinking water line being in separate trenches with the drinking water line located above the gravity sewer line with a minimum vertical separation of 18 inches (18") measured from the bottom of the drinking water line to the top of the gravity sewer line; or shall be laid in parallel in the same trench with the drinking water line being on an undisturbed earth shelf above the gravity sewer line with minimum vertical separation of 18 inches (18") measured from the bottom of the drinking water line to the top of the sewer line; shall be laid at crossings with a minimum vertical separation of 18 inches (18") measured from the outside of the gravity sewer line to the outside of the drinking water line regardless of which line is above the other line with gravity sewer line joints and the drinking water line joints being equidistant and as far as possible from each other.